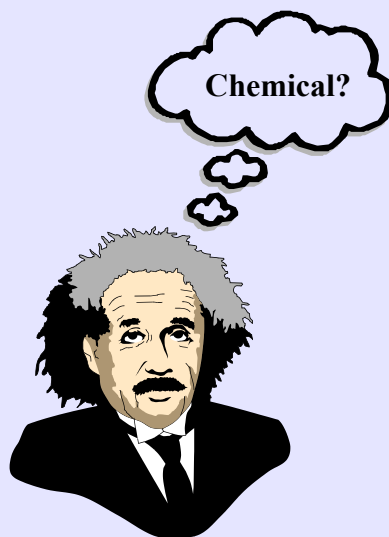


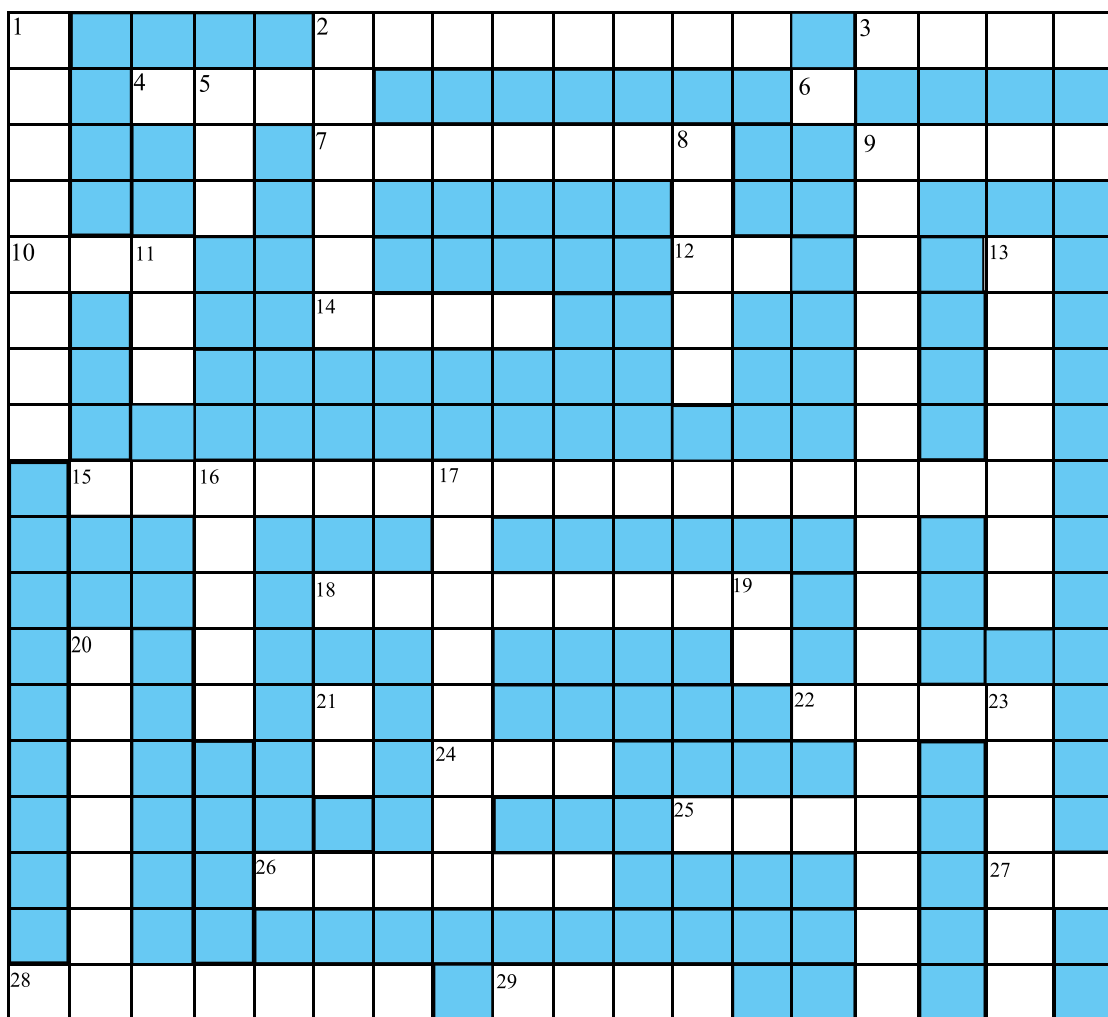
Chemistry Revision Themes

Quick Crosswords



Crossword One

Atomic Structure Quick Xword



Across:

2. A dumb-bell shaped space in which to find an electron.
3. In the iron atom, in which numbered shell are the outer s electrons?
4. Not so much a bore, more an enlightened scientist.
6. A pale yellow coloured halogen.
7. A space in which to find an electron.
9. Fe.
10. Cry's when you try to bend it.
12. Just 3 electrons.
14. Pretty lights.
15. Used to measure the mass of atomic and molecular particles.
18. You get one of these when you pass light through a prism.
22. An element with four outer electrons.
24. Calcium can look like this when heated.
25. How many s electrons in a sodium atom?
26. What is the atomic number of calcium?
27. A red element.
28. Neon-22 is one of three.
29. Orbitals.

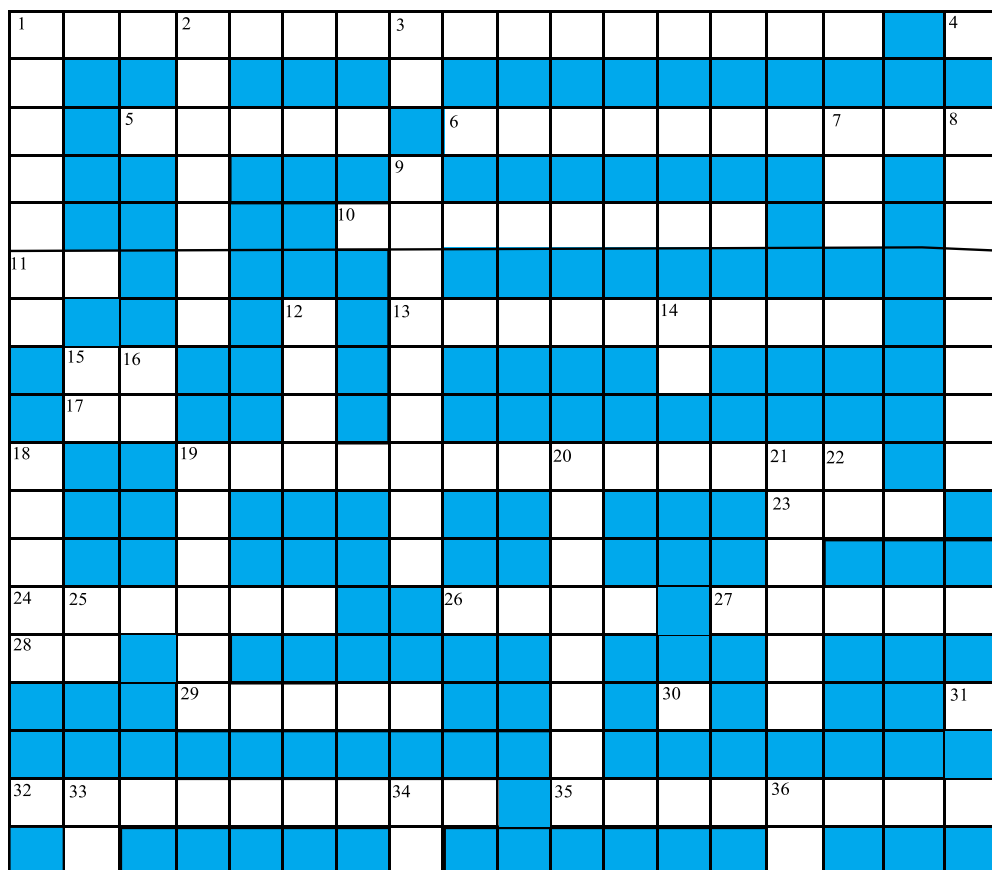
Down:

1. What type of charge is carried by a cation?
2. A nucleon with a positive charge.
5. Which numbered shell has the lowest energy?
8. If sodium gives a yellow flame test what does potassium give?
9. As you go across a period from L to R this increases.
11. How many p electrons does Be have?
13. This nucleon has no electrical charge.
16. A principal energy level.
17. This is infinitesimally small, very elusive and negatively charged.
19. Which element has the electronic structure, 2,8,2?
20. Very, very small but extremely heavy.
21. It has just one 6s electron.
23. Is the calcium ion singly or doubly charged?

Answers page 17

Crossword Two

Chemical Bonding & Structures Quick Xword



Across:

1. Weak intermolecular bonds (3,3,4,6).
4. It has the highest melting point of any metal (symbol).
5. He formulated rules helping to decide the degree of covalency of a solid.
6. As a general rule, are organic compounds high melting or low melting?
10. Distort (with respect to an electron cloud).
11. An excellent conductor of heat and electricity (symbol).
13. The attractive force between two oppositely charged ions (5,4).
15. This gives a lilac flame test and a yellow precipitate with silver nitrate solution (formula).
17. A highly electronegative element (formula).
19. These are responsible for the relatively high boiling point of water (8,5).
23. This melts at zero centigrade and floats on water.
24. This sublimates and, in the vapour state, is comprised of isolated diatomic molecules.
26. The amount of carbon in 12 g of the carbon twelve isotope.
27. Built of ions.
28. This molecule is comprised of two atoms which can be envisaged as being held together by two sigma bonds and a dative bond (formula).
29. Lead is one.
30. This element is a gas. It is relatively unreactive because the atoms in its diatomic molecules are triply bonded and difficult to separate. (symbol)
31. An element which forms molecular rings consisting of 8 atoms. (symbol)
32. Opposite of ionic.
35. An adjective describing how a piece of graphite feels to the touch.

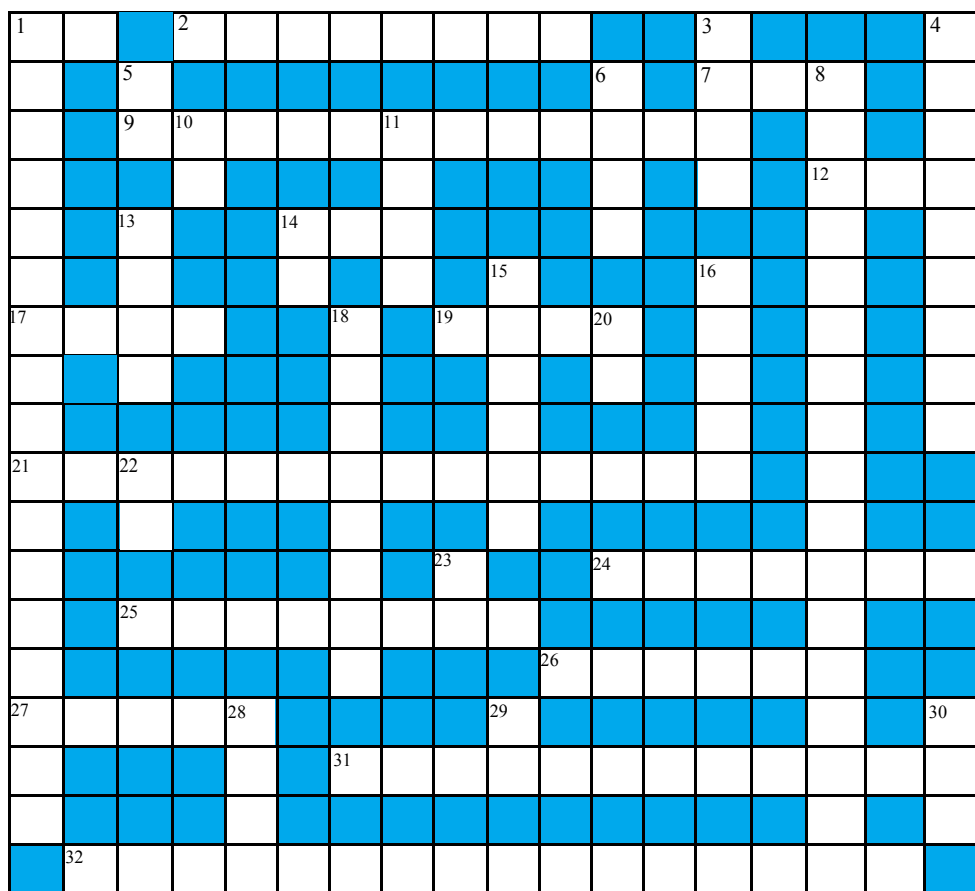
Down:

1. Number of bonds an atom or group can form.
2. An allotrope of carbon.
3. The chloride of this metal has considerable covalent character (symbol).
7. A charged particle.
8. A non metal structure which has layers of hexagonally arranged atoms.
9. Electrovalent attractive force (5,4).
12. Exceedingly malleable.
14. The chloride of this element forms dimers and chains (symbol).
15. Halide of a group I element (formula).
16. A crystalline halogen (formula).
18. The shape of sodium chloride crystals.
19. This gas boils at 4 K.
20. General name of an element in group 0 in the periodic table.
21. Unequal charge distribution.
22. An element in the first transition series (symbol).
25. A gaseous diatomic molecule in which the atoms are doubly bonded (formula).
33. An allotrope of oxygen (formula).
34. An element with the electronic structure, 2,8,8 (symbol).
36. A *doughnut* shaped covalent bond.

Answers page 17

Crossword Three

Formulae, Equations, The Mole Quick Xword



Across:

1. The second most abundant element in the earth's crust (symbol).
2. Salts containing water of crystallisation.
7. The number of moles of sodium in 23 g of the metal.
9. In the equation for the reaction of aq silver nitrate with aq sodium chloride the nitrate group is an example of this (9,3).
12. A halogen containing plastic (abbrev.).
14. A sodium halide (formula).
17. This colour becomes apparent when water is added to anhydrous copper sulphate.
19. The English for *mole*.
21. 6×10^{23} .
24. These are formed when metal atoms lose outer electrons.
25. NaO, CuO, and CaO contain this anion.
26. If you breathe this gas your voice sounds squeaky.
27. Air contains about 1% of this gas.
31. One mole of any gas occupies 24 litres at rtp.
32. The volume occupied by 2 g of hydrogen at rtp (10,6).

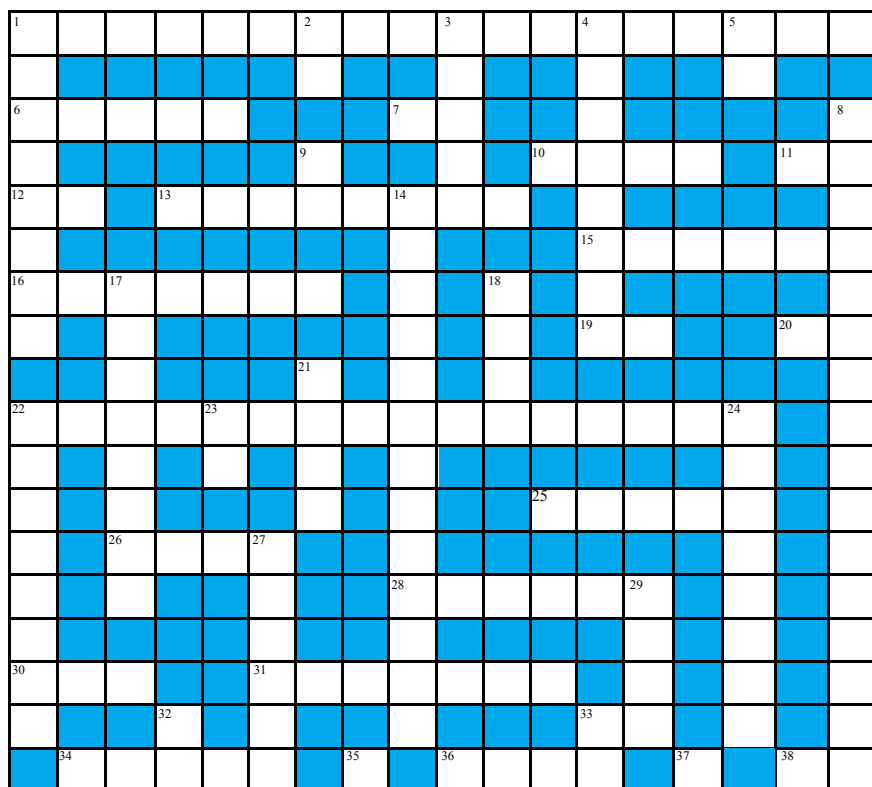
Down:

1. This is the common name of the main constituent of baking powder.
3. Charged atomic particles.
4. This is formed when calcium carbonate is heated strongly.
5. This element has a sinister, dark, side to its character (symbol)!
6. This is formed when lithium is added to water (formula).
8. CH (for ethyne) and CH₃ (for ethane) are examples of these.
10. A very expensive white metal (symbol).
11. When one of these is added to a carbonate carbon dioxide is evolved.
13. A table salt dispenser weighs 50 g. When full of sodium chloride it weighs 284 g. How many moles of salt are contained in the dispenser?
14. Sir William Ramsay discovered this gas in 1898 (symbol).
15. The Latin for *iron*.
16. The most abundant compound on the earth's surface.
18. This substance accounts for over 90% of the material content of the Universe.
20. A heavy metal but it is still only the 20th most dense element (symbol).
22. Karl Scheele called it, *fire air*. Joseph Priestley called it, *dephlogisticated air* (formula).
23. The formula of a gas which burns with a clear blue flame.
28. The name of this element derives from the Latin for *new*.
29. Quicksilver (symbol).
30. The number of moles of calcium carbonate corresponding to 200 g of the compound.

Answers page 17

Crossword Four

The Periodic Table Quick Xword



Across:

1. The metals in group II in the periodic table have a family name. Calcium is one of these. (8, 5, 5)
6. A vertical arrangement of elements in the periodic table.
7. A metal which burns with a blinding white light. (symbol)
10. A gift from the three wise men.
11. A reddish-brown, highly toxic, element. (symbol)
12. A gaseous element used in advertising. (symbol)
13. Moissan received the Nobel prize in 1906 for isolating this very reactive element.
15. The number of electrons in a sodium atom.
16. In 1789 this element was named by the German chemist, Martin Klaproth, after a planet which had been discovered eight years previously. The element is an *actinide*.
19. This element is found in group IV in the periodic table. It has a metallic appearance and a very high melting point. (symbol)
20. Which is the least reactive of the alkali metals? (symbol)
22. The father of the periodic table. (7, 9)
25. In 1808 the French chemist, Joseph Gay-Lussac, isolated this group III element by heating its oxide with potassium. The pure element burns for a short period with a brilliant green flame when heated above 500 C.
26. This is in the first transition series. However, it is not considered to be a transition element.
28. This is an element in group six and was discovered by Scheele.
30. The number of outer electrons in a selenium atom.
31. The horizontal arrangements of elements in the periodic table.
33. This metal is used to help protect iron from rusting. (symbol)
34. In 1882 this German physician and chemist received the Davy medal (of the Royal Society) which he shared jointly with the Russian chemist Mendeleev.
35. This element produces a violet coloured vapour when heated. (symbol)
36. A transition metal important in the construction industry.
37. Brimstone. (symbol)
38. A group I element whose name derives from the Latin for *sky blue*. (symbol)

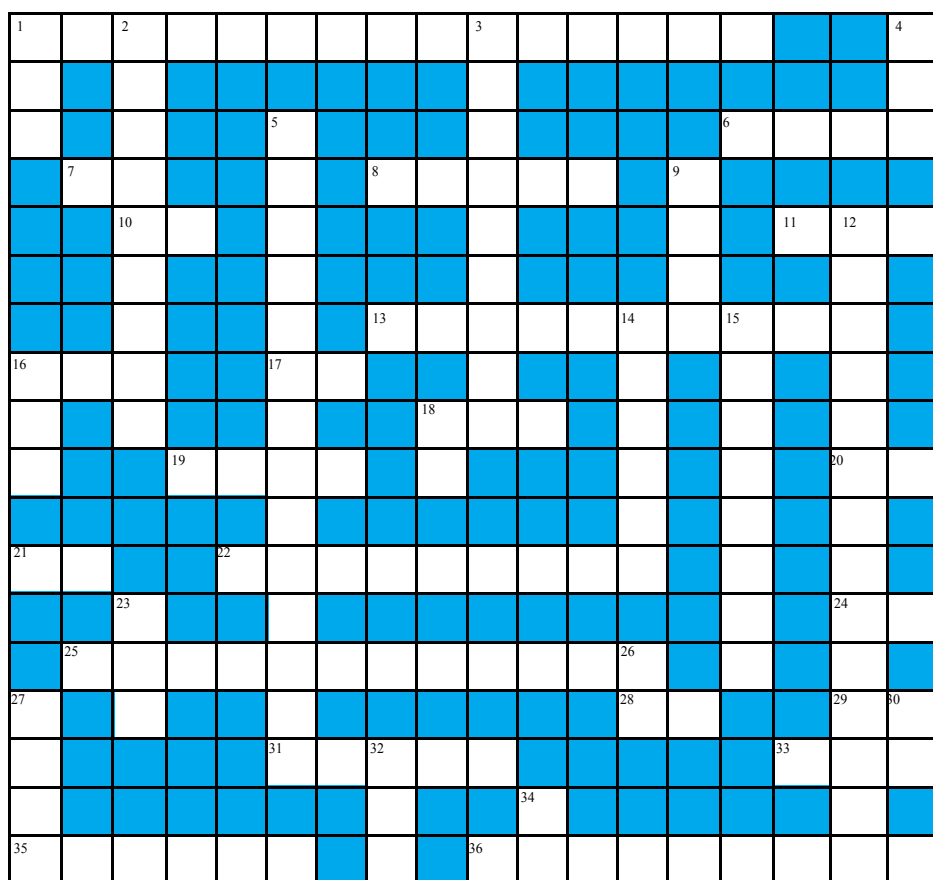
Down:

1. A noble metal.
2. An alkali metal in period three. (symbol)
3. In 1894 William Ramsay and John Rayleigh named this element from the Greek for *inert*.
4. Salt makers.
5. This element is in the first transition series. It is a very strong metal and melts at nearly 1700 C. It was named after gods in Greek mythology. (symbol)
8. A characteristic of these elements is that they each have a number of oxidation states. They form a large family having many properties in common.
9. At the time, it was widely reported that a Russian double agent was assassinated by being given this radioactive element in his food or drink. (symbol)
14. We apply this term to atoms or ions with the same number and arrangement of electrons.
17. As you go down a group of elements in the periodic table the value of this *increases*. (4, 4)
18. The carbonate of this metal has been used as a paint pigment. It is, however, poisonous.
21. An element has moderately high electronegativity, it exhibits covalent bonding and it forms yellow and red allotropes. In which group does it occur in the periodic table?
22. As you go from left to right across period 3 does electrical conductivity increase or decrease?
23. This is a transition element and was discovered by the Swedish chemist A.G.Ekeberg in 1802. It was a tantalizing task to track it down! (symbol)
24. This element is in the first transition series. It has a total of five 3d & 4s electrons.
27. This is a coinage metal and many of its compounds are blue or green.
29. The second element in group zero.
32. An element discovered in 1886 by the French chemist, Lecoq de Boisbaudran (who also discovered gallium much to the excitement of Mendeleev) having a relative atomic mass of 162. (symbol)
33. Between germanium and lead. (symbol)

Answers page 17

Crossword Five

Oxidation & Reduction Quick Xword



Across:

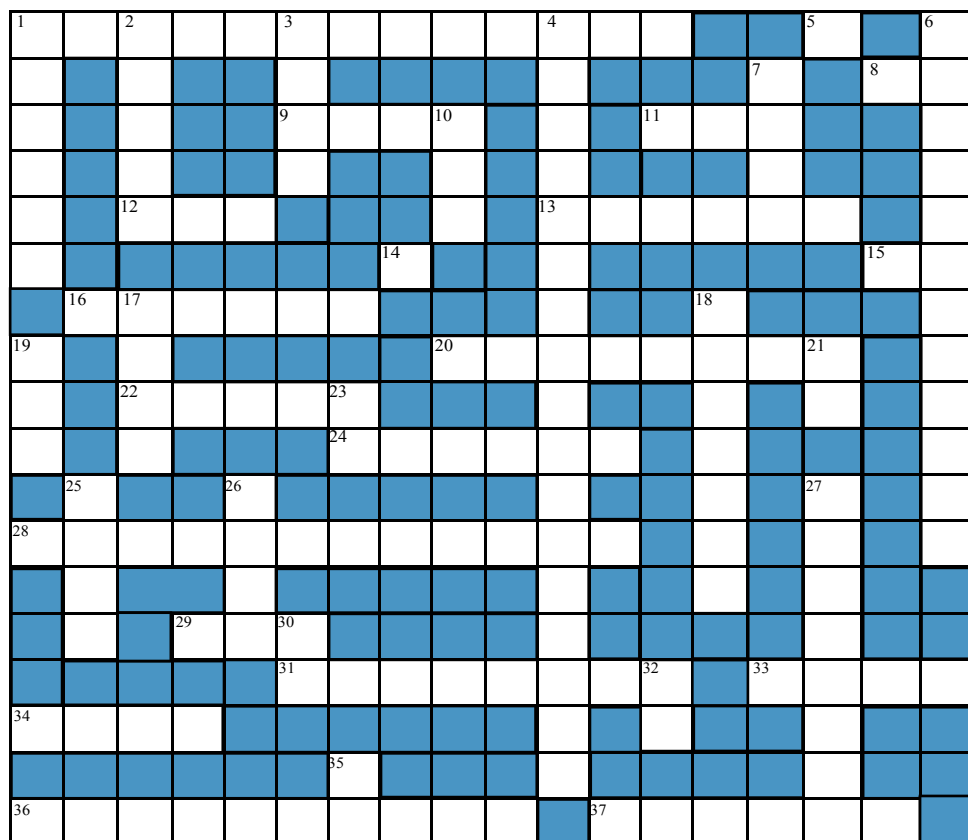
1. In the 1770's Karl Scheele and Joseph Priestley made an important element by heating this metallic compound. (7,3,5)
6. When heated with concentrated hydrochloric acid this metal oxide oxidises the acid to produce chlorine. (form)
7. This metal occurs naturally. (symb)
8. An abbreviated form of *oxidation-reduction*.
10. This carbon oxide is readily oxidised. (form)
11. Carbon dioxide. (form)
13. An English interpretation of *oxygen* (Greek). (4,6)
16. The change in oxidation number when copper is oxidised to CuO.
17. Can be oxidised to silica. (symb)
18. The change in oxidation number when chlorine is oxidised to chloride ion.
19. The *sum* of the oxidation numbers of lead, in litharge, and manganese in permanganate ion.
20. When iron(II) is converted to iron(III) is the metal reduced?
21. This is formed at the cathode, as a reduction product, when copper sulphate solution is electrolysed. (symb)
22. An oxidation product of iron.
24. This is readily oxidised to a brown gas. (form)
25. Not the whole equation. (4,8)
28. This gas cannot be oxidised or reduced. (symb)
29. Add together the oxidation numbers of V(V), P(V), Fe(III) and Cu(II). (Roman numerals)
31. Subtract the oxidation number of chloride ion from the oxidation number of the zinc ion.
33. The oxidation number of sulphur in sulphur trioxide.
35. Oxidation is loss of electrons, reduction is the gain of electrons. (3,3)
36. Oxidation number of aluminium in alumina. (4,5)

Down:

1. This substance is formed when magnesium is left in contact with air. (form)
2. The process occurring when copper sulphide is converted to copper metal.
3. The process occurring when zinc metal reacts with dilute sulphuric acid.
4. This gas is formed when sulphur is burnt in air. (form)
5. Each of the following is an example; chlorine, permanganate, ozone, nitrate, oxygen and hydrogen peroxide. (9,5)
9. The difference between oxidation numbers of Mn, in permanganate, and Fe in haematite.
12. Reduces iron oxide in the blast furnace. (6,8)
14. The colour of a popular oxidising anion used in organic chemistry.
15. Oxidation number of oxygen in SnO. (5,3)
16. Multiply the oxidation number of V in vanadium pentoxide by 2.
18. This is evolved when hydrogen peroxide is reduced. (form)
23. In this sodium salt hydrogen has an oxidation number of -1. (form)
26. This is formed at the cathode during the electrolysis of molten sodium chloride. (symb)
27. The oxidation number of an element.
30. The addition of the common oxidation numbers of iron. (Roman numerals)
32. The colour of dilead(II)lead(IV) oxide.
34. This element is in group III. It has a stable +1 oxidation state which is extremely poisonous and in trace amounts turns the hair black! (symb)

Crossword Six

Inorganic Chemistry Quick Xword



Across:

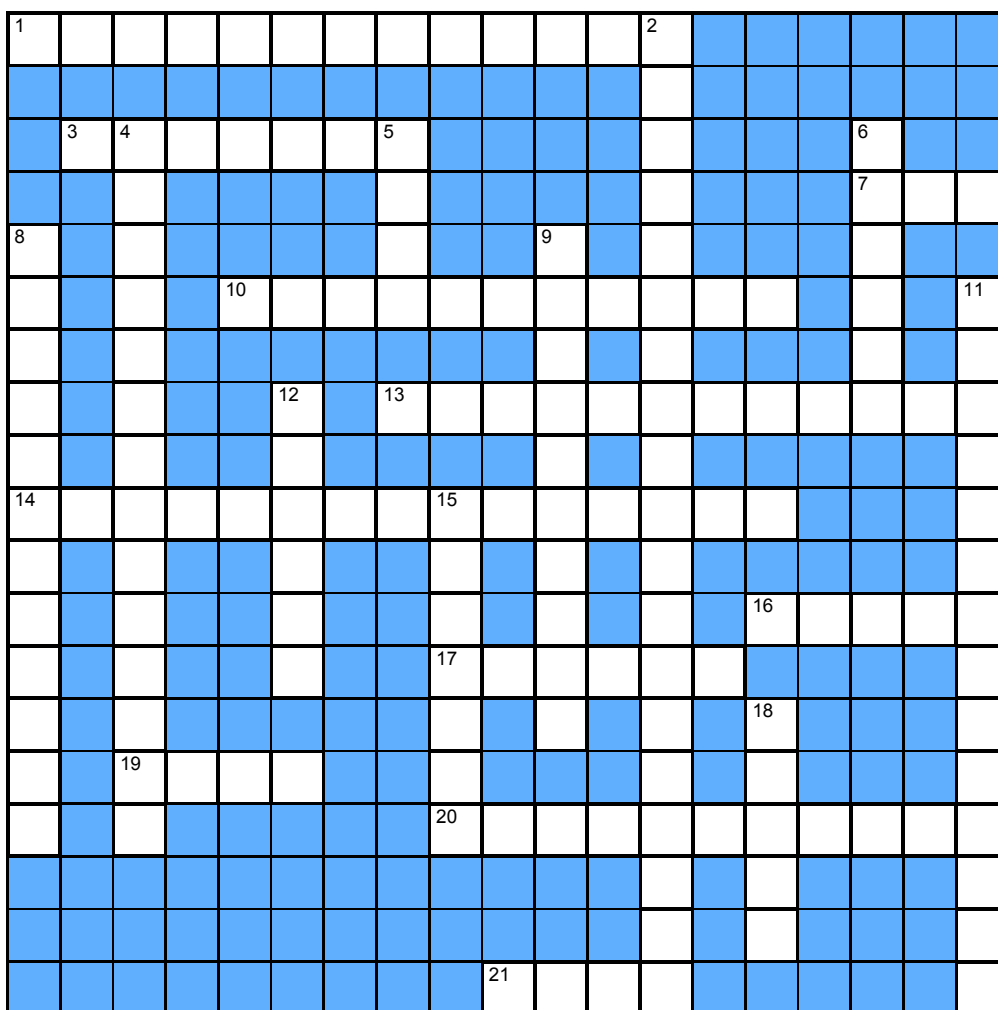
1. Halogens. (4,9)
5. A transition element with six oxidation states. (symb)
8. Gives a squeaky voice. (symb)
9. An alkali metal hydroxide which gives a blue flame test. (form)
11. The oxidation number of the alkali metals in their salts.
12. An alkaline earth metal oxide used by farmers. (form)
13. This is a slippery, corrosion resistant, plastic.
14. One or more of the oxidation states of a transition element has this orbital partially filled.
15. Green flame test. (symb)
16. Made by allowing chlorine to react with cold sodium hydroxide solution.
20. A property of polytetrafluoroethane. (3,5)
22. 1% of the Earth's atmosphere.
24. The colour of vanadium(V) oxide.
28. A component of *Chile saltpetre*. (6,6)
29. When treated with dilute hydrochloric acid it gives hydrogen sulphide and a pale green solution. (form)
31. Distort an electron cloud.
33. The shape of water and sulphur dichloride molecules.
34. Impure silicon dioxide.
36. This atomic property decreases across period three and increases down group 4. (4,6)
37. A good hydrogenation catalyst.

Down:

1. Gives a blue colour with iodine.
2. K's flame colour.
3. This white crystalline solid gives a red flame test and its aqueous solution gives a white precipitate with silver nitrate solution. (form)
4. The tendency of an atom in a covalent bond to attract electrons.
6. An electrical apparatus used commercially to make chlorine and sodium hydroxide. (8,4)
7. The oxidation number of alkali and alkaline earth metals.
10. A colourless poisonous gas which fumes in moist air and has a very pungent smell. (form)
17. Roofing material.
18. An allotrope of carbon.
19. Litharge. (form)
21. An aqueous solution of this salt readily dissolves iodine. (form)
23. A combination of a group five element with a group six element produces this colourless gas. (form)
25. An aqueous solution of this reacts with HCl, in a disproportionation reaction, giving chlorine.
26. Melt.
27. The change in first electron affinity down group seven.
30. Overlap of these two orbitals provides a sigma bond.
32. High energy d orbitals in an octahedral complex.
35. Theatrical sounding transition element. (symb)

Crossword Seven

Chemical Equilibria Quick Xword



Across

- 1 A catalyst for the contact process. (13)
 3 The colour of acidified bromine water. (7)
 7 The yield when the Contact process is operated at low pressure. (3)
 10 The French chemist who stated that, 'when the conditions of a system in equilibrium are altered, the position of equilibrium changes in such a way as to try and restore the original conditions'. (11)
 13 The ratio of the partial pressure of a reactant to the total pressure. (12)
 14 The pressure a reactant would exert if it alone

- occupied the same volume as the reaction mixture at the same temperature. (15)
 16 In which direction does the equilibrium of the Haber process move when temperature is lowered? (5)
 17 The colour of an alkaline solution of potassium dichromate. (6)
 19 An aqueous solution of ethanoic acid contains a small amount of ethanoate ion. What must be added to reduce the concentration of ethanoate ion still further? (4)
 20 When ammonia is decomposed into nitrogen and hydrogen is the heat

change endothermic or exothermic? (11)

- 21 In which direction does the equilibrium of the Contact process move when the concentration of oxygen in the equilibrium mixture is reduced? (4)

Down

- 2 Concentrations of products over the concentrations of reactants. (19)
 4 A law proposed by Guldberg & Waage. (14)
 5 If, for a particular reaction, the equilibrium constant is a large value what is the expected magnitude of the yield of product? (4)

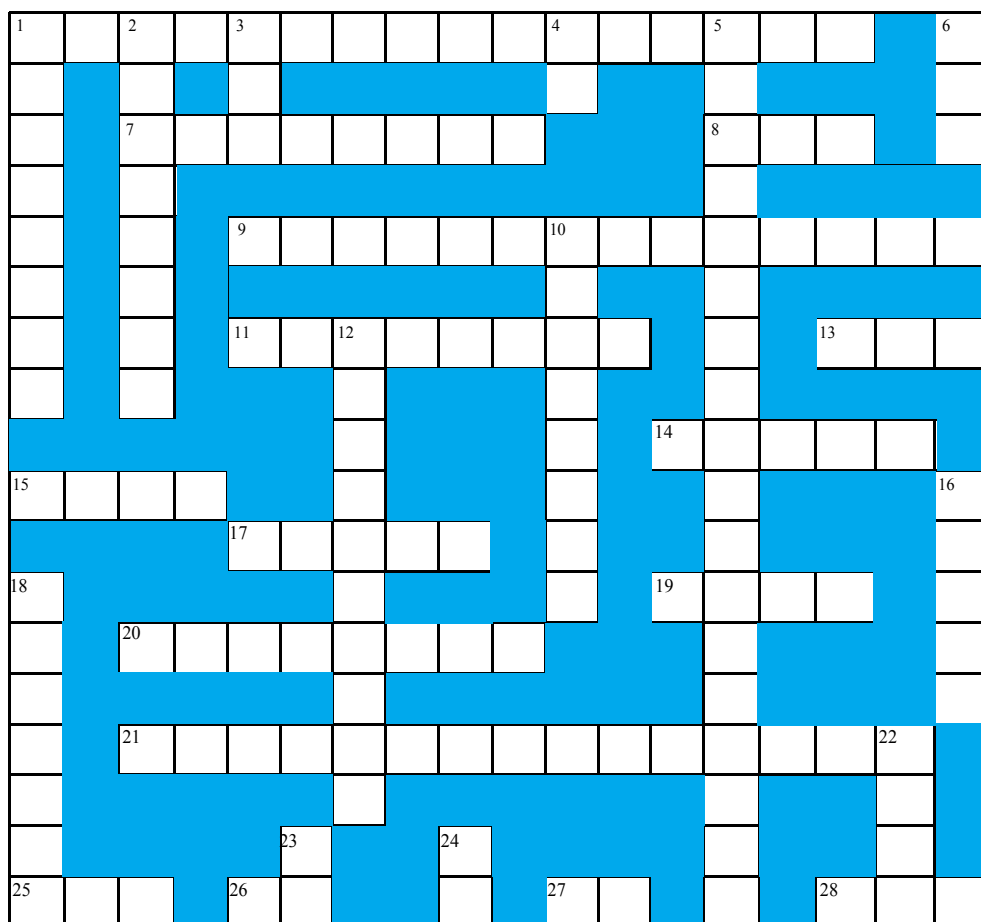
6 A solution of a strong base. (6)

- 8 A method for manufacturing ammonia. (12)
 9 A term applied to reactions which exhibit dynamic equilibrium. (10)
 11 A way of making sulphur(VI) oxide. (14)
 12 The colour observed when potassium dichromate solution is made acidic. (6)
 15 Use again. (7)
 18 In chemical manufacture conditions are optimised to achieve maximum ----- (5)

Answers page 17

Crossword Eight

Chemical Energetics Quick Xword



Across:

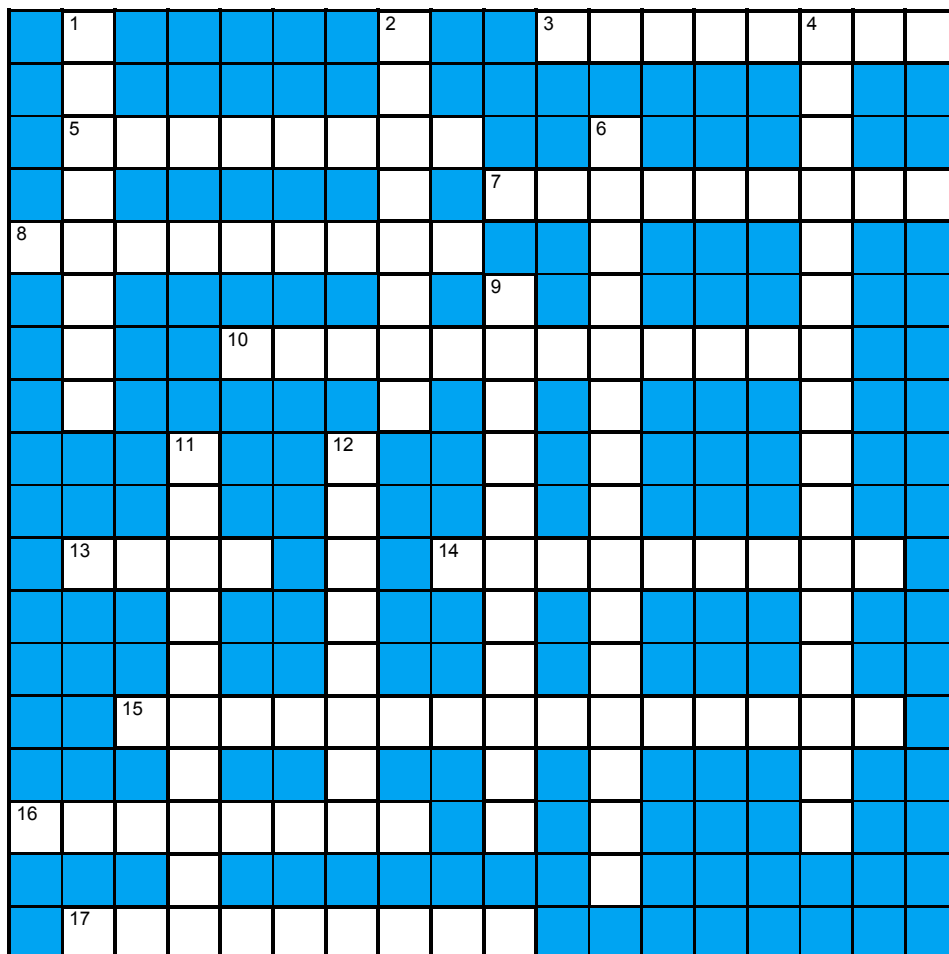
1. Paraffin, petrol and diesel are important examples. (11,5)
7. Everyone of these is equivalent to 4.18 joules.
8. Standard pressure in atmospheres.
9. The exchange of energy between a reaction and its surroundings when the reaction takes place at constant pressure. (8,6)
11. The change in solubilities of the hydroxides of group 2 from magnesium to barium?
13. A product from the combustion of organic compounds. (form)
14. He lends his name to free energy change.
15. In an endothermic reaction the system gains heat from the surroundings - true or false?
17. SI unit of energy.
19. In order for a reaction to be feasible its free energy change must been this number of kilojoules or less.
20. For an endothermic change this sign precedes the heat change value.
21. The enthalpy change when a compound is formed from its elements under standard conditions.(4,2,9)
25. In the hydrogenation of ethene, if the average bond enthalpies of the reactants is 2699 kJ and the average bond enthalpies of the products is 2824 kJ is the enthalpy if reaction exothermic in excess of 100 kJ?
26. At a temperature above 140 degrees Celsius nitrogen dioxide produces this gas. (form)
27. This gas is prepared by the catalytic oxidation of ammonia. (form)
28. Does entropy decrease when water freezes?

Down:

1. The enthalpy change is the same whether a reaction takes place in one step or a number of steps. (5,3)
2. The change in the solubilities of the sulphates of group 2 elements magnesium to barium.
3. Lubricant.
4. Does the entropy of nitrogen(IV) oxide increase when it is cooled from room temperature to temperatures below 20 degree C?
5. This description applies to the combustion of methane. (10,8)
6. The number of kilojoules of heat energy absorbed when 1 mole of graphite is converted to 1 mole of diamond.
10. The sign in front of the enthalpy of solution of barium sulphate.
12. The process when ethanol is combined with oxygen to give carbon dioxide and water.
16. A comment on the statement that, "the enthalpies of solution of the group 2 hydroxides decrease down the group".
18. Molecular disorder.
22. Consider the thermal decomposition of ammonium carbonate. Add five to the number of moles of products.
23. Is the enthalpy of formation of methane endothermic?
24. When copper(II) sulphate solution is electrolysed using copper electrodes what is formed at the cathode? (symbol)

Crossword Four

Chemical Kinetics Quick Xword



Across

- 3** The effect of raising reaction temperature on reaction rate. (8)
- 5** A substance which changes the rate of reaction. (8)
- 7** He established the relationship between absolute temperature and reaction rate. (9)
- 8** Reaction steps. (9)
- 10** For a first order reaction this constant has the units of reciprocal time. (12)
- 13** The order with respect to iodine in the reaction between iodine and propanone under acidic conditions. (4)
- 14** A reaction in which the rate does not change with increase in reactant concentration. (9)
- 15** This was developed to help explain how changes in conditions affect the rate of reaction. (15)
- 16** In the reaction of zinc with dilute hydrochloric acid what is the preferred physical state of the metal to ensure rapid reaction? (8)

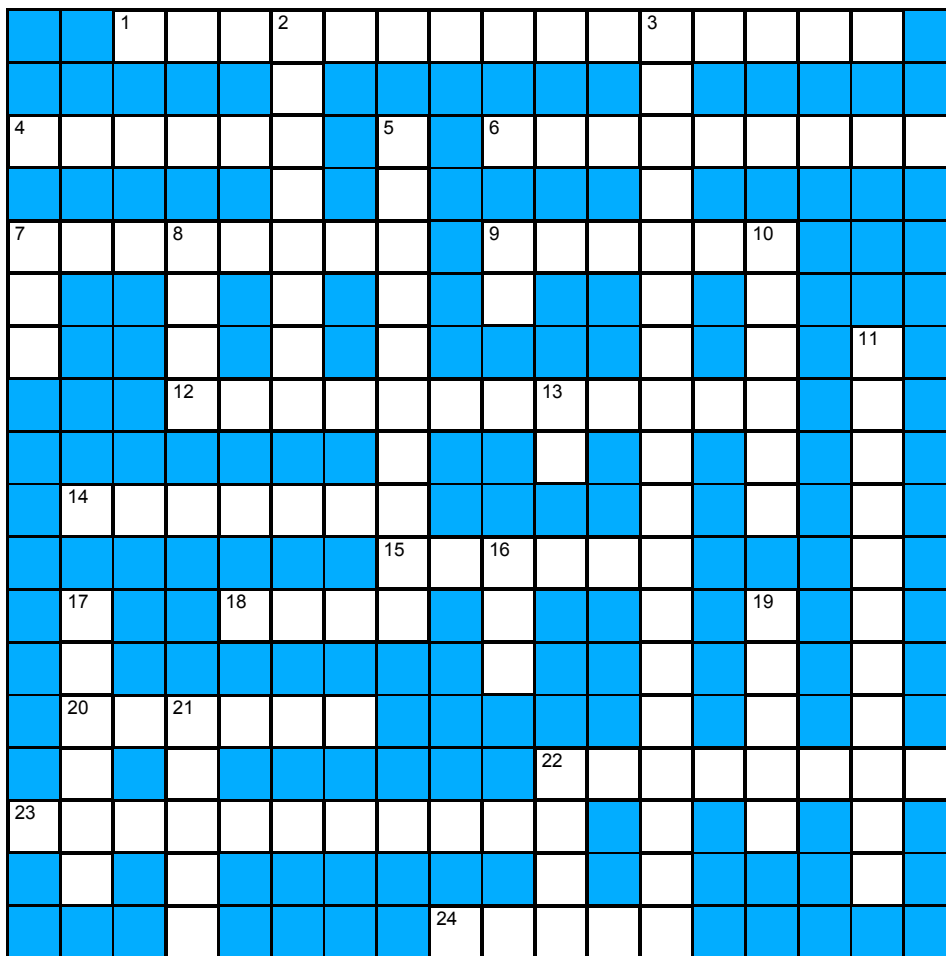
- 17** He is credited with coining the term, catalyst. (9)

Down

- 1** The change in rate when a reaction is cooled. (8)
- 2** A non-rate determining stage in a reaction sequence. (8)
- 4** The minimum energy required to get colliding reactant molecules to combine. (16)
- 6** A high energy molecular structure formed as a result of the successful collision of reactant molecules. (15)
- 9** A reaction in which the reactants are all in the same physical state. (11)
- 11** A type of reaction in which the rate increases linearly with increase in the concentration of reactant. (10)
- 12** The time it takes for reagent concentration to diminish by 50% during chemical reaction. (8)

Crossword Ten

Organic Chemistry I Quick Xword



Across

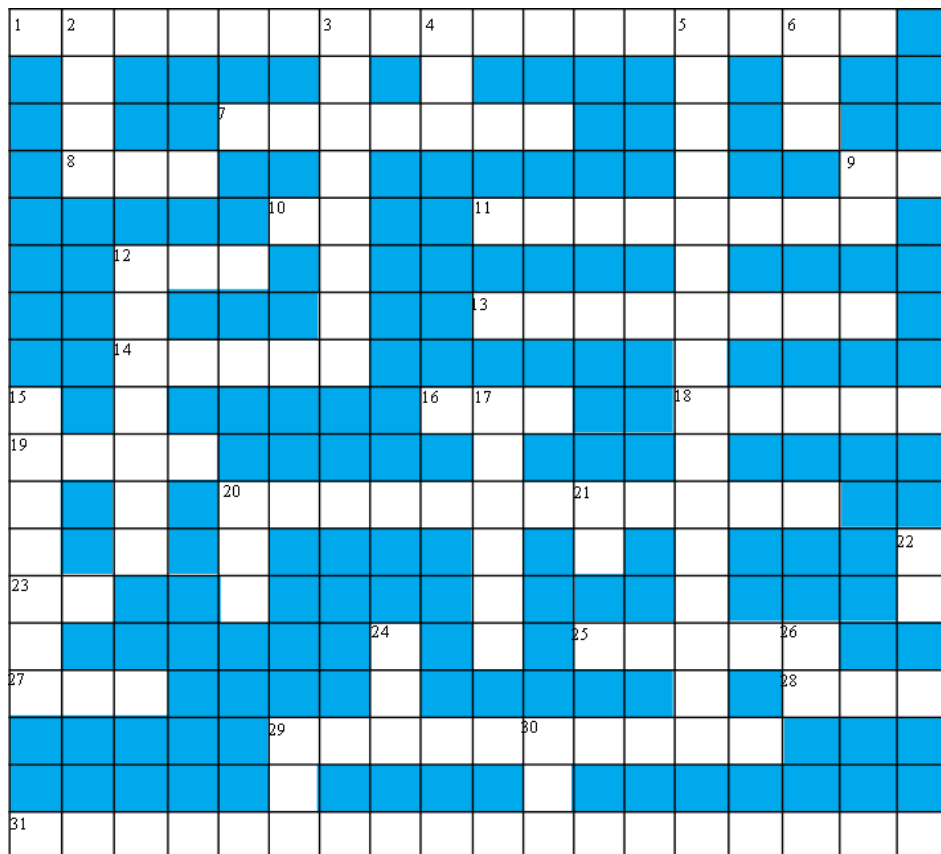
- 1 Mostly responsible for the chemistry of an organic molecule. (15)
- 4 A reactive covalent bond. (6)
- 6 The type of alcohol with the group, -CHOH-. (9)
- 7 The third member of the aliphatic aldehyde series. (8)
- 9 A major constituent of Scot pine oil. (6)
- 12 Seeks electrons to form a covalent bond. (12)
- 14 A simple aromatic molecule. (7)
- 15 A good hydrogenation catalyst. (6)
- 18 High melting polyethene. (4)
- 20 A molecule containing the -CO- group. (6)
- 22 The major constituent of the oil from orange peel. (8)
- 23 This term applies to the alkenes. (11)
- 24 These are good examples: methane, propane, butane and ethanol. (5)
- 3 But-2-ene has a couple of these. (18)
- 5 Can be made by heating ethene to a high temperature under pressure. (10)
- 7 Polyethylene terephthalate (abbrev). (3)
- 8 Made by polymerising tetrafluoroethene (abbrev). (4)
- 9 Polymerise phenylethene (abbrev). (2)
- 10 A molecule of this compound has two carbon atoms and four hydrogen atoms. (6)
- 11 These organic substances can be synthesised by reacting alcohols, under suitable conditions, with a variety of halogen containing compounds. (11)
- 13 Polymerised propene (abbrev). (2)
- 16 Opposite of trans. (3)
- 17 A saturated hydrocarbon. (6)
- 19 A compound which contains nitrogen and can be synthesised by refluxing a halogenoalkane with ammonia in alcohol. (5)
- 21 The most stable geometrical isomer of but-2-ene. (5)
- 22 This manufactured by heating ethene to a high temperature and pressure in the presence of oxygen catalyst. (4)

Down

- 2 A constituent of the fragrance of ophrys orchids and highly attractive to pollinating bees. (8)

Crossword Eleven

Organic Chemistry II Quick Xword



Across

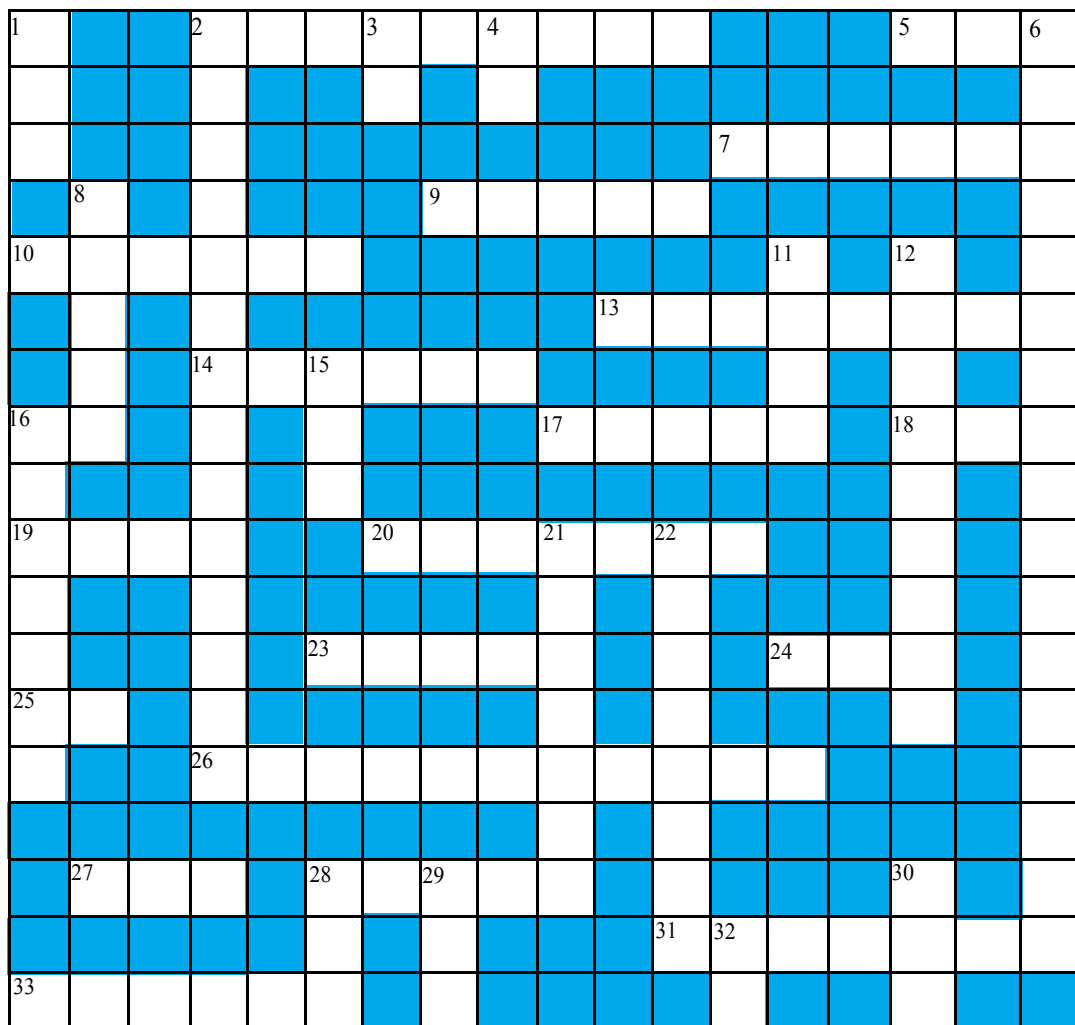
1. The region in an infra-red spectrum below 1500 wavenumbers. (11,6)
7. This reagent gives a silver mirror with aldehydes.
8. The suffix for ketone.
9. This negatively charged group acts as the nucleophile in the hydrolysis of haloalkanes.
10. Low energy electromagnetic radiation.
11. A primary alcohol in the essential oil of geranium.
12. The formula of a reagent used to convert alcohols to iodoalkanes.
13. A name for the -COOH group.
14. A layer in the upper atmosphere.
16. This inorganic reagent is required to synthesise nitriles.
18. The number of carbon atoms in heptanol.
19. On the coast of Australia red alga grow on a very large one of these.
20. A layer above the troposphere.
23. The aldehyde suffix.
25. Do simple, saturated, alcohols burn with a *clean* flame or a *dirty* flame?
27. Is it true to say that, under the same conditions, bromoethane is hydrolysed more readily than chloroethane?
28. The number of carbon atoms in dibromomethane.
29. Cr₂O₇
31. The vibration of a water molecule in which both OH bonds expand in unison. (11,7)

Down

2. The prefix in the name of C₂H₅I.
3. Blond bears love this. (5,3)
4. The substance of a glacier.
5. Over heating of the troposphere due to retention of ir radiation. (10,6)
6. The suffix for -COOH.
9. The suffix for alcohol.
12. The second alkene.
15. What type of alcohol group is -CH₂OH?
17. Steam distillation of these gives eugenol.
20. Add up the number of atoms in a benzene molecule and divide by 2.
21. A weak covalent bond.
22. An abbreviation for boiling point.
24. Ozone destroying agent.
26. Is a hydrogen ion a nucleophile?
29. Insecticide used to combat mosquito.
30. North Sea

Crossword Twelve

Organic Chemistry III Quick Xword



Down

1. Prefix for six
2. A 1:1 mixture of enantiomers (7,7)
3. Suffix for alcohol
4. Suffix for aldehyde
6. Reducing agent (6,11)
8. A group containing nitrogen & oxygen
11. Carboxyl group
12. 1700 cm^{-1}
15. Prefix for three
16. Caraway seed oil
21. Propanone
22. German word meaning, *opposite*
28. Suffix for $\text{C}_n\text{H}_{2n+2}$
29. Suffix for $\text{C}=\text{C}$ group
30. A glass device used to aid sample collection in distillation
32. An abbreviation for a type of radiation

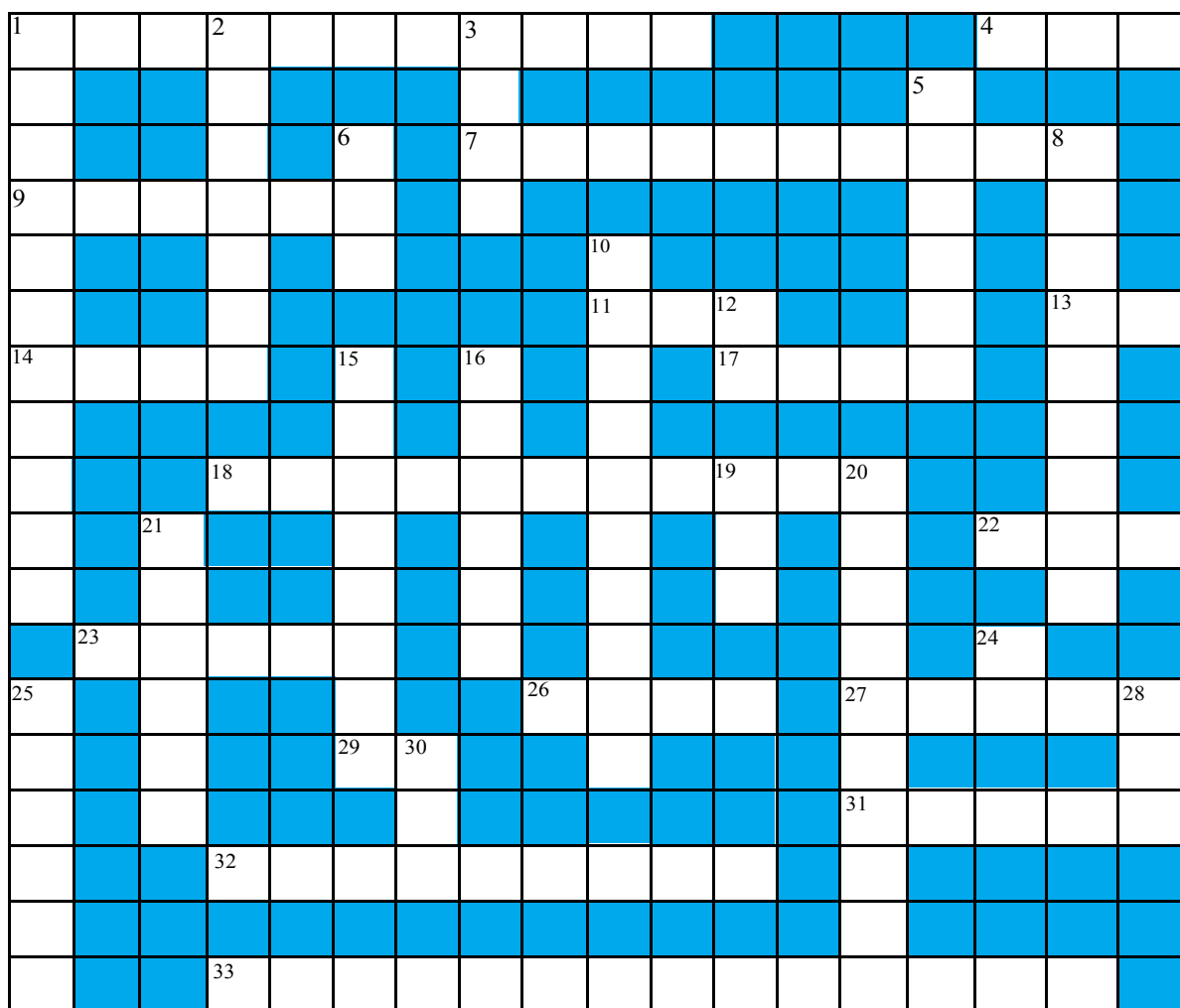
Across

2. The state of a molecule which can be represented by two or more conventional formulae (*canonical forms*)
5. The Z form of but-2-ene
7. A molecular structure which has characteristics of two or more other structures
9. The product of an acid and an alcohol
10. An acid-base indicator
13. A bright yellow solid with an antiseptic smell
14. A naturally occurring substance present in lemongrass oil
16. The formula for an oxide of carbon
17. Some ants produce this
18. You get this number if you divide the number of carbon atoms in benzene by 3
19. The general formula of a Grignard reagent
20. A German word meaning, *together*
23. A nitrogen containing organic compound
24. The systematic name for acetic acid ends with this
25. Symbol for a transition metal which catalyses hydrogenation
26. Structures with a mirror image relationship
27. A type of dye
28. A highly unsaturated hydrocarbon
31. One of these gives a carboxylic acid and an ammonium salt on acid hydrolysis
33. He thought of the ring structure for benzene

Answers page 17

Crossword Thirteen

Acid-Base Equilibria Quick Xword



Across:

1. One half of a buffer equation team.
4. Minus log K_a .
7. End point detectors.
9. A very small piece of material.
11. A charged particle.
13. Minus log hydrogen ion concentration.
14. Is the hydrogen ion concentration of 0.01M NaOH *more* or *less* than ten to the minus 11 mol per litre?
17. Opposite of acid.
18. A compound which conducts electricity in the molten state and when dissolved in water.
22. What is the pH of 10^{-6} molar HCl?
23. Aqua.
26. The smallest representative part of an element.
27. Thomas Martin ----- published a theory of acids and bases in 1923.
29. Is zero the lowest pH an aqueous solution can have?
31. Proton acceptors.
32. An alkali indicator.
33. A tribasic acid.

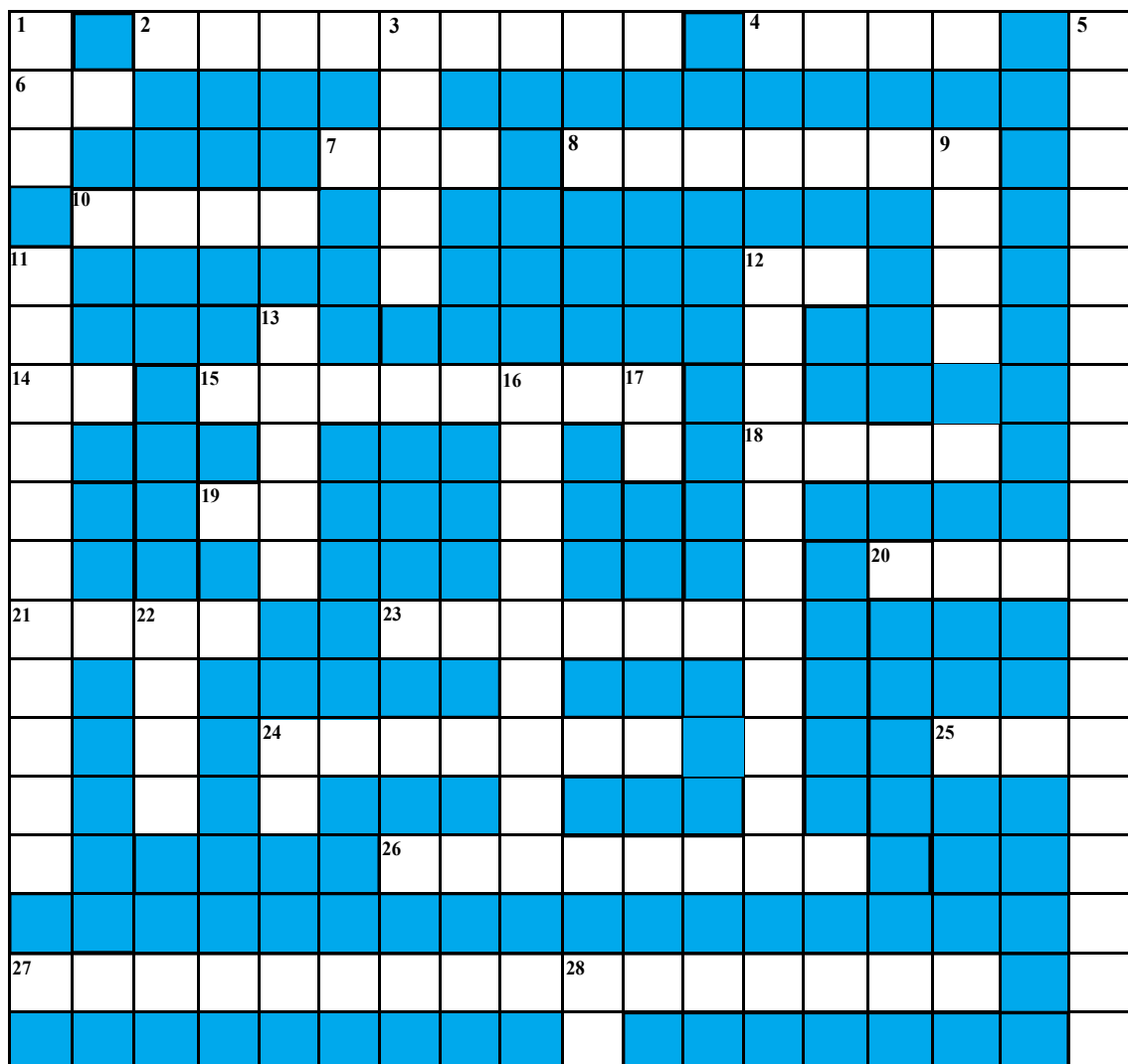
Down:

1. A large protein molecule having a ring-like chemical structure containing an atom iron(II).
2. Dissolved compounds.
3. Opposite of base.
5. To produce ions.
6. What is the pH of 10^{-4} molar NaOH?
8. A dibasic acid.
10. A molecule which breaks up into two or more smaller particles is said to do this.
12. Niobium.
15. A negatively charged particle.
16. A positively charged particle?
19. Does ammonia turn red litmus blue?
20. What is the plural of equilibrium?
21. The colour of methyl orange in alkali.
24. The ionic product of water.
25. Stops trains.
28. Does the word *acid* come from the Latin meaning, sour?
30. Calms water?

Answers page 17

Crossword Fourteen

Redox Equilibria Quick Xword



Across:

2. To protect with zinc.
4. Roofing material.
6. Low density reactive metal.
7. A charged particle.
8. Alternative of Galvanic.
10. Hydrated iron oxide.
12. A silvery, precious, metal.
14. Nickel.
15. One half of a battery.
18. The number of electrons in a Faraday.
19. Combined with lead it makes solder and combined with copper it makes pewter.
20. A compound made from an acid and a base.
21. Is it the convention to place the negative electrode on the left or the right in the shorthand notation of a voltaic cell?
23. A convenient source of electricity.
24. The negative electrode.
25. Sn.
26. An electrochemical cell which converts hydrogen and oxygen into water.
27. Electrode used to protect metallic structure from corrosion.

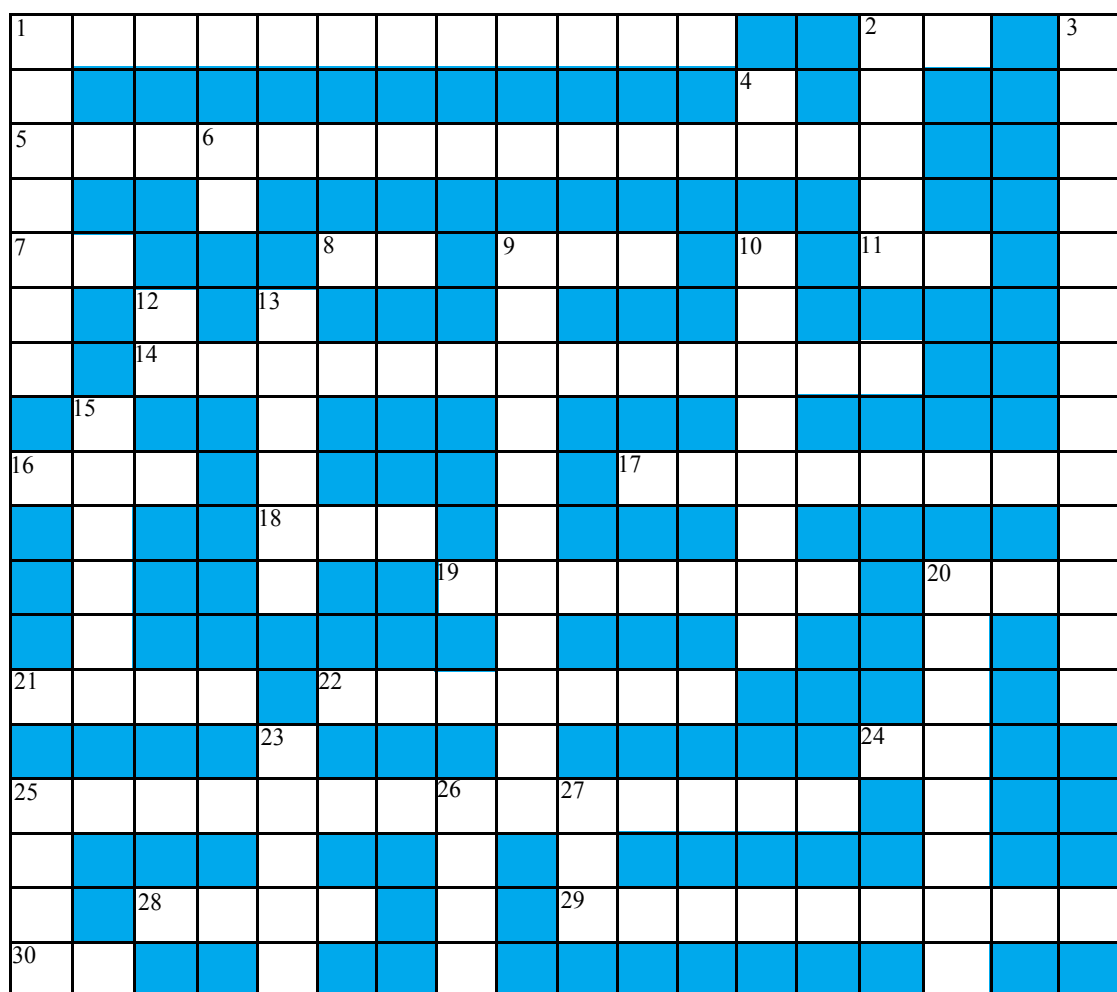
Down:

1. Measures the voltage of an electrochemical cell.
3. Opposite of cathode.
5. A process in which an element undergoes redox in a reaction.
9. The electrochemical version of this has electrical potential.
11. The first reliable battery.
12. A simple battery.
13. A protective film.
16. This is used to allow electrons to flow in or out of an electrochemical device.
17. An alkali metal.
22. The sum of the oxidation numbers of the zinc ion, the magnesium ion and the hydrogen ion.
24. The symbol of the main constituent of *Nickel-silver* alloy.
28. Aluminium.

Answers page 17

Crossword Fifteen

Industrial Chemistry Quick Xword



Across

1. Chlorine is manufactured in one of these (8,4).
2. A p-block element with a very high boiling point.
5. This is made by nitrating methybenzene.
7. A popular party gas.
8. Its main ore is bauxite.
9. An oxide of iron.
11. A metal which gives a red flame test.
14. Made by the Contact process.
16. This is used industrially to make steel.
17. A weapon used with devastating & horrific effect in the 1914-18 War.
18. A black oxide of copper.
19. A branded bleach.
20. Quicklime.
21. The element with the electronic structure 2,8,14,2.
22. Hot air pipes.
24. Forms a brown gas with air.
25. A source of dihydrogenphosphate ion.
28. This element has an oxide which is white when cold and yellow when hot.
29. A vital constituent of matches.
30. A few bars of this would help you combat the credit crunch!

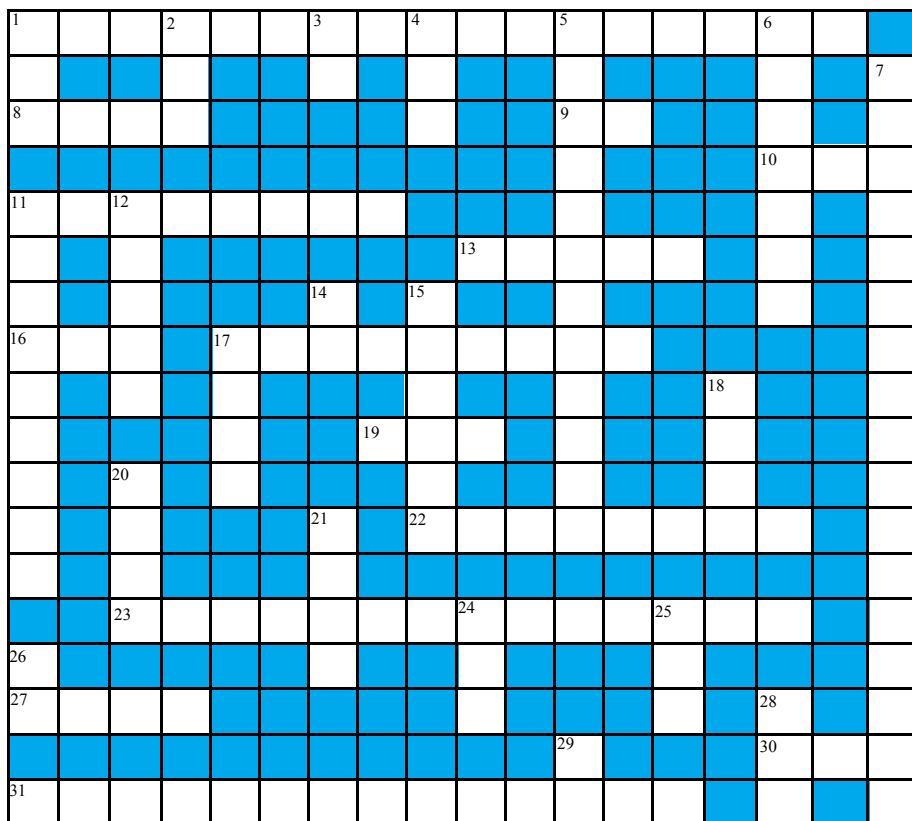
Down

1. Strike anywhere.
2. Really useful construction material.
3. North Africa and Florida provide good sources of this mineral (9,4).
4. These lights provide a cheerful sight in city centres.
6. A coinage metal and useful hydrogenation catalyst.
9. Ammonium nitrate and potassium chloride are important examples.
10. Stewing in acid.
12. The oxide of this metalloid is toxic and has been used as a vermin poison.
13. A solution of sodium chlorate(I) and caustic soda.
15. A pink or rose coloured metal.
20. Sodium aluminofluoride.
23. Salty water.
25. A hygiene product made from fats.
26. Minerals from which metals can be extracted for commercial gain.
27. This is made by heating chloroethene in the presence of peroxide.

Answers page 17

Crossword Sixteen

Organic Analysis Quick Xword



Across:

1. Indicators of true identity (9,2,5).
8. Haematite and bauxite are examples.
9. High energy electromagnetic radiation (abbrev).
10. A useful product from chlorine (abbrev).
11. When sample peaks in a chromatogram are separated we say they are -----.
13. The displacement of a peak from the internal standard in pmr spectroscopy.
16. The number of pmr peaks corresponding with an isolated methine group.
17. A French chemist who originated the sodium fusion test.
19. A gas chromatography detector (abbrev).
22. Another way of saying that the protons in TMS are *protected* from the influence of the applied magnetic field.
23. Colour writing.
27. Do isolated methyl protons occur at *high* field or *low* field in a pmr spectrum?
30. It turns anhydrous copper(II) sulphate blue (formula).
31. $A = \epsilon lc$ (4,7,3).

Down:

1. Gives a positive with Tollen's (formula).
2. An internal standard in nmr (abbrev).
3. A type of spectroscopy used to identify functional groups (abbrev).
4. Spectroscopy of the nucleus (abbrev).
5. A complex iron cyanide indicating positive for nitrogen in the sodium fusion test (8,4).
6. The pmr absorption pattern of a methine proton adjacent to a methylene group.
7. Repeated purification of a solid.
11. Flipping of an atomic nucleus from low energy to high energy.
12. The number of pmr peaks corresponding with an isolated ethyl group.
14. A type of spectrometry (abbrev).
15. His name is synonymous with a digestion tube.
17. Coupled separation and detection method (abbrev).
18. The number of protons in chloromethoxymethane.
20. Supercharged chromatographic technique (abbrev).
21. Very sensitive mass spectrometry (abbrev).
24. How many peaks are there in the pmr spectrum of chloroform?
25. Magnetic juggling of protons (abbrev).
26. This group gives intense absorption at about 3500 wavenumbers (formula).
28. This functional group gives a pmr peak between 9& 10 ppm (formula).
29. Compounds which have a name ending with this suffix absorb strongly at 1700 wavenumbers.

Answers page 17

Crossword Answers

Atomic Structure: Across: 2. porbital 3. four 4. Bohr 6. F 7. orbital 9. Fe 10. tin 12. Li 14. neon 15. mass spectrometer 18. spectrum 22. lead 24. red 25. five 26. twenty 27. Br 28. isotope 29. spdf. **Down:** 1. positive 2. proton 5. one 8. lilac 9. ionisation energy 11. non 13. neutron 16. shell 17. electron 19. Mg 20. nucleus 21. Pt 23. Doubly.

Chemical Bonding & Structures: Across: 1. Van der waal forces. 4. W. 5. Fajan. 6. low melting. 10. polarise. 11. Cu. 13. ionic bond. 15. KI. 17. F2. 19. hydrogen bonds. 23. ice. 24. iodine. 26. mole. 27. ionic. 28. CO. 29. metal. 30. N. 31. S. 32. molecular. 35. slippery. **Down:** 1. valency. 2. diamond. 3. Al. 7. ion. 8. graphite. 9. ionic bond. 12. Gold. 14. Be. 15. KF. 16. I2. 18. cubic. 19. helium. 20. noble gas 21. dipole. 22. Sc. 25. OO (ie, O=O). 33. O3. 34. Ar. 36. pi.

Formulae, Equations The Mole: Across: 1. Si. 2. hydrates. 7. one. 9. spectator ion. 12. PVC. 14. NaI. 17. blue. 19. heap. 21. Avogadro number. 24. cations. 25. oxide ion. 26. helium. 27. argon. 31. Avogadros law. 32. twenty four litres. **Down:** 1. sodium bicarbonate. 3. ions. 4. quicklime. 5. As. 6. LiOH. 8. empirical formulae. 10. Pt. 11. acid. 13. four. 14. Ne. 15. ferrum. 16. water. 18. hydrogen. 20. Pb. 22. O2. 23. CO. 28. neon. 29. Hg. 30. two.

The Periodic Table: Across: 1. Alkaline earth metals. 6. Group. 7. Mg. 10. gold. 11. Br. 12. Ne. 13. fluorine. 15. eleven. 16. uranium. 19. Si. 20. Li. 22. Dimitri Mendeleev. 25. boron. 26. zinc. 28. oxygen. 30. six. 31. periods. 33. Sn. 34. Meyer. 35. I. 36. iron. 37. S. 38. Cs. **Down:** 1. argentum. 2. Na. 3. argon. 4. halogens. 5. Ti. 8. transition metals. 9. Po. 14. isoelectronic. 17. atom size. 18. lead. 21. five. 22. decrease. 23. Ta. 24. vanadium. 27. copper. 29. neon. 32. Dy. 33. Sn.

Oxidation & Reduction: Across: 1. mercury two oxide. 6. MnO2. 7. Au. 8. redox. 10. CO. 11. OCO (ie, O=C=O). 13. acid former. 16. two. 17. Si. 18. one. 19. nine. 20. no. 21. Cu. 22. haematite. 24. NO. 25. half equation. 28. Ar. 29. XV. 31. three. 33. six. 35. oilrig. 36. plus three. **Down:** 1. MgO. 2. reduction. 3. oxidation. 4. SO2. 5. oxidising agent. 9. four. 12. carbon monoxide. 14. orange. 15. minus two. 16. ten. 18. O2. 23. NaH. 26. Na. 27. zero. 30. VX. 32. red. 34. Tl.

Inorganic Chemistry: Across: 1. Saltproducers. 5. V. 8. He. 9. CsOH. 11. One. 12. CaO. 13. Teflon. 14. D. 15. Ba. 16. Bleach. 20. Nonstick. 22. Argon. 24. Orange. 28. Sodium iodate. 29. FeS. 31. Polarise. 33. Bent. 34. Sand. 36. Atom radius. 37. Nickel. **Down:** 1. Starch. 2. Lilac. 3. RbCl. 4. Electronegativity. 6. Membrane cell. 7. Zero. 10. HCl. 17. Lead. 18. Diamond. 19. PbO. 21. KI. 23.

Chemical Equilibria: Across: 1. Vanadium oxide. 3. Reddish. 7. Low. 10. Le Chatelier. 13. Mole fraction. 14. Partial pressure. 16. Right. 17. Yellow. 19. Acid. 20. Endothermic. 21. Left. **Down:** 2. Equilibrium constant. 4. Equilibrium law. 5. High. 6. Alkali. 8. Haber process. 9. Reversible. 11. Contact process. 12. Orange. 15. Recycle. 18. Yield.

Chemical Energetics: Across: 1. Hydrocarbon fuels. 7. Calories. 8. One. 9. Enthalpy change. 11. Increase. 13. OCO. 14. Gibbs. 15. True. 17. Joule. 19. Zero. 20. Positive. 21. Heat of formation. 25. Yes. 26. No. 27. NO. 28. Yes. **Down:** 1. Hesss law. 2. Decrease. 3. Oil. 4. No. 5. Exothermic reaction. 6. Two. 10. Positive. 12. Combustion. 16. False. 18. Entropy. 22. Nine. 23. No. 24. Cu.

Chemical Kinetics: Across: 3. Increase. 5. Catalyst. 7. Arrhenius. 8. Mechanism. 10. Rate constant. 13. Zero. 14. Zero order. 15. Collision theory. 16. Powdered. 17. Berzelius. **Down:** 1. Decrease. 2. Fast step. 4. Activation energy. 6. Transition state. 9. Homogeneous. 11. First order. 12. Half life.

Crossword Answers (continued)

Organic Chemistry I: Across: 1. Functional group. 4. Pi bond. 6. Secondary. 7. Propanal. 9. Pinene. 12. Electrophile. 14. Benzene. 15. Nickel. 18. HDPE. 20. Ketone. 22. Limonene. 23. Unsaturated. 24. Fuels. **Down:** 2. Cadinene. 3. Geometrical isomers. 5. Polyethene. 7. PET. 8. PTFE. 9. PS. 10. Ethene. 11. Haloalkanes. 13. PP. 16. Cis. 17. Alkane. 19. Amine. 21. Trans. 22. LDPE.

Organic Chemistry II: Across: 1. Fingerprint region. 7. Tollens. 8. One. 9. OH. 10. IR. 11. Geraniol. 12. PI3. 13. Carboxyl. 14. ozone. 16. KCN. 18. Seven. 19. Reef. 20. Stratosphere. 23. al. 25. Clean. 27. Yes. 28. One. 29. Dichromate. 31. Symmetrical stretch. **Down:** 2. Iodo. 3. Polar ice. 4. Ice. 5. Greenhouse effect. 6. OIC. 9. ol. 12. Propene. 15. Primary. 17. Cloves. 20. Six. 21. Pi. 22. Bp. 24. CFC. 26. No. 29. DDT. 30. Oil.

Organic Chemistry III: Across: 2. Resonance. 5. Cis. 7. Hybrid. 9. Ester. 10. Litmus. 13. Iodoform. 14. Citral. 16. CO. 17. HCOOH. 18. Two. 19. RMgX. 20. Zusammen. 23. Amine. 24. oic. 25. Ni. 26. Enantiomers. 27. Azo. 28. Arene. 31. Nitrile. 33. Kekule. **Down:** 1. Hex. 2. Racemic mixture. 3. ol. 4. al. 6. Sodium borohydride. 8. Nitro. 11. COOH. 12. CO stretch. 15. Tri. 16. Carvone. 21. Acetone. 22. Entgegen. 28. ane. 29. ene. 30. Pig. 32. IR.

Acid-Base Equilibria: Across: 1. Hasslebalch. 4. pKa. 7. Indicators. 9. Minute. 11. Ion. 13. pH. 14. Less. 17. Base. 18. Electrolyte. 22. Six. 23. Water. 26. Atom. 27. Lowry. 29. No. 31. Bases. 32. Redlitmus. 33. Phosphoric acid. **Down:** 1. haemoglobin. 2. Solutes. 3. Acid. 5. Ionise. 6. Ten. 8. Sulphuric. 10. Dissociate. 12. Nb. 15. Electron. 16. Cation. 19. Yes. 20. Equilibria. 21. Orange. 24. Kw. 25. Buffer. 28. Yes. 30. Oil.

Redox Equilibria: Across: 2. Galvanise. 4. Lead. 6. Mg. 7. Ion. 8. Voltaic. 10. Rust. 12. Pt. 14. Ni. 15. Half cell. 18. Mole. 19. Sn. 20. Salt. 21. Left. 23. Batttery. 24. Cathode. 25. Tin. 26. Fuel cell. 27. Sacrificial anode. **Down:** 1. EMF. 3. Anode. 5. Disproportionation. 9. Cell. 11. Daniell cell. 12. Primary cell. 13. Paint. 16. Electrode. 17. Li. 22. Five. 24. Cu. 28. Al.

Industrial Chemistry: Across: 1. Membrane cell. 2. Si. 5. Trinitrotoluene. 7. He. 8. Al. 9. FeO. 11. Li. 14. Sulphuric acid. 16. BOP. 17. Chlorine. 18. CuO. 19. Miltons. 20. CaO. 21. Iron. 22. Tuyeres. 24. NO. 25. Superphosphate. 28. Zinc. 29. Chlorate V. 30. Pt. **Down:** 1. Matches. 2. Steel. 3. Phosphate rock. 4. Ne. 6. Ni. 9. Fertilizers. 10. Pickling. 12. As. 13. Bleach. 15. Copper. 20. Cryolite. 23. Brine. 25. Soap. 26. Ores. 27. PVC.

Organic Analysis: Across: 1. Criterion of purity. 8. Ores. 9. UV. 10. PVC. 11. Resolved. 13. Shift. 16. One. 17. Lassaigne. 19. FID. 22. Shielded. 23. Chromatography. 27. High. 30. H₂O. 31. Beer Lambert Law. **Down:** 1. CHO. 2. TMS. 3. IR. 4. NMR. 5. Prussian blue. 6. Triplet. 7. Recrystallisation. 11. Resonance. 12. Seven. 14. MS. 15. Carius. 17. LCMS. 18. Five. 20. HPLC. 21. HRMS. 24. One. 25. PMR. 26. OH. 28. CHO. 29. al.